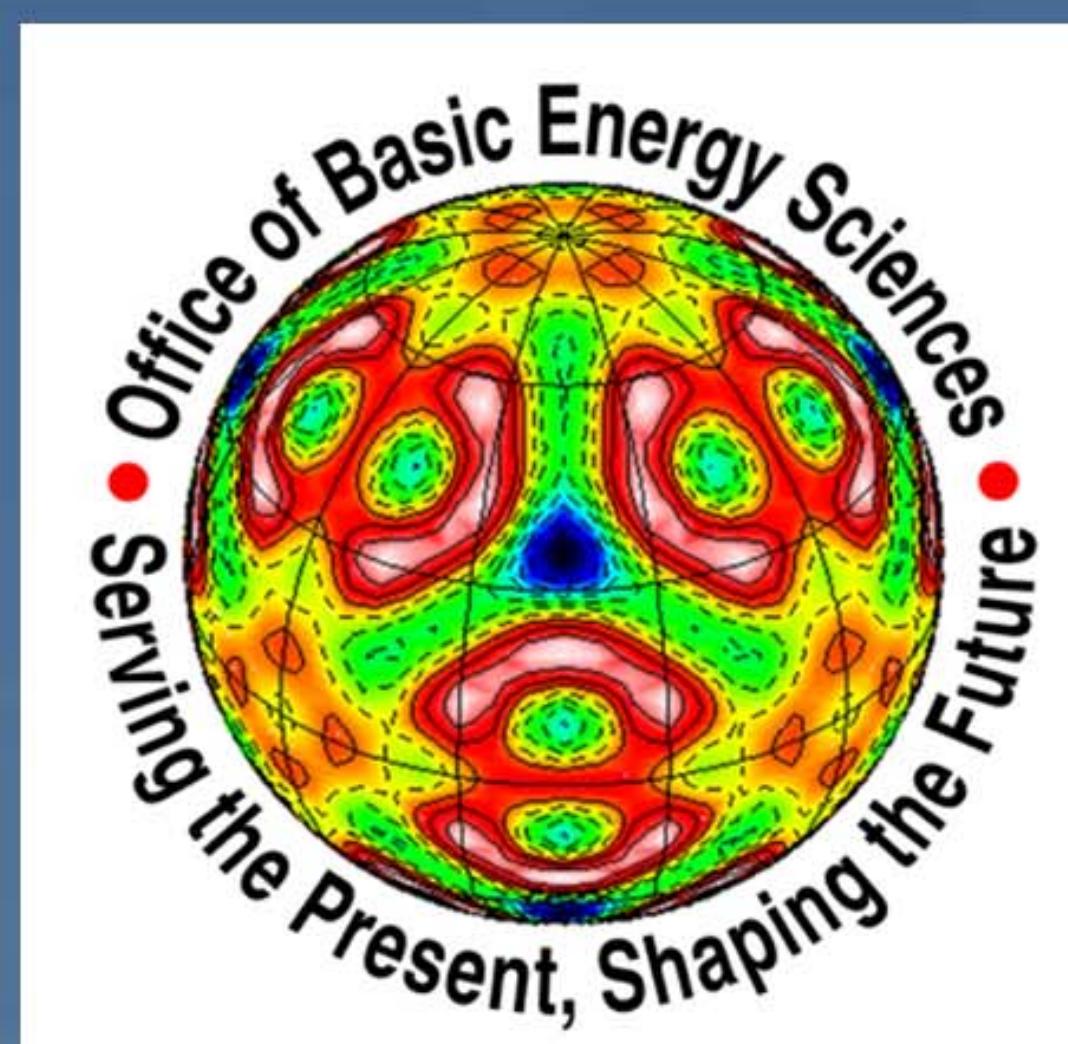


# TOUGHENING OF SILICON BY DEFECT ENGINEERING AT THE NANOSCALE



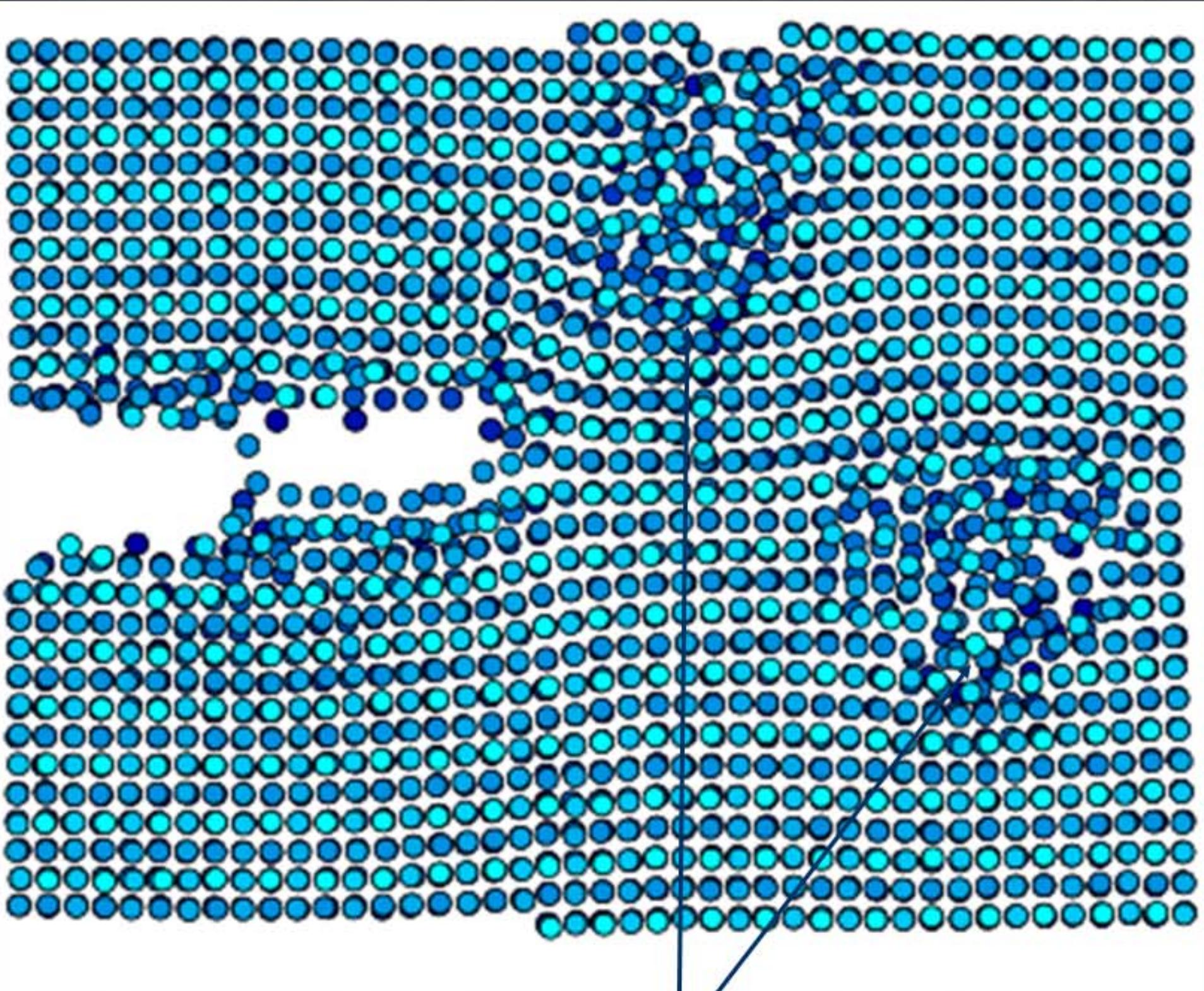
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\* MST-8, Los Alamos National Laboratory

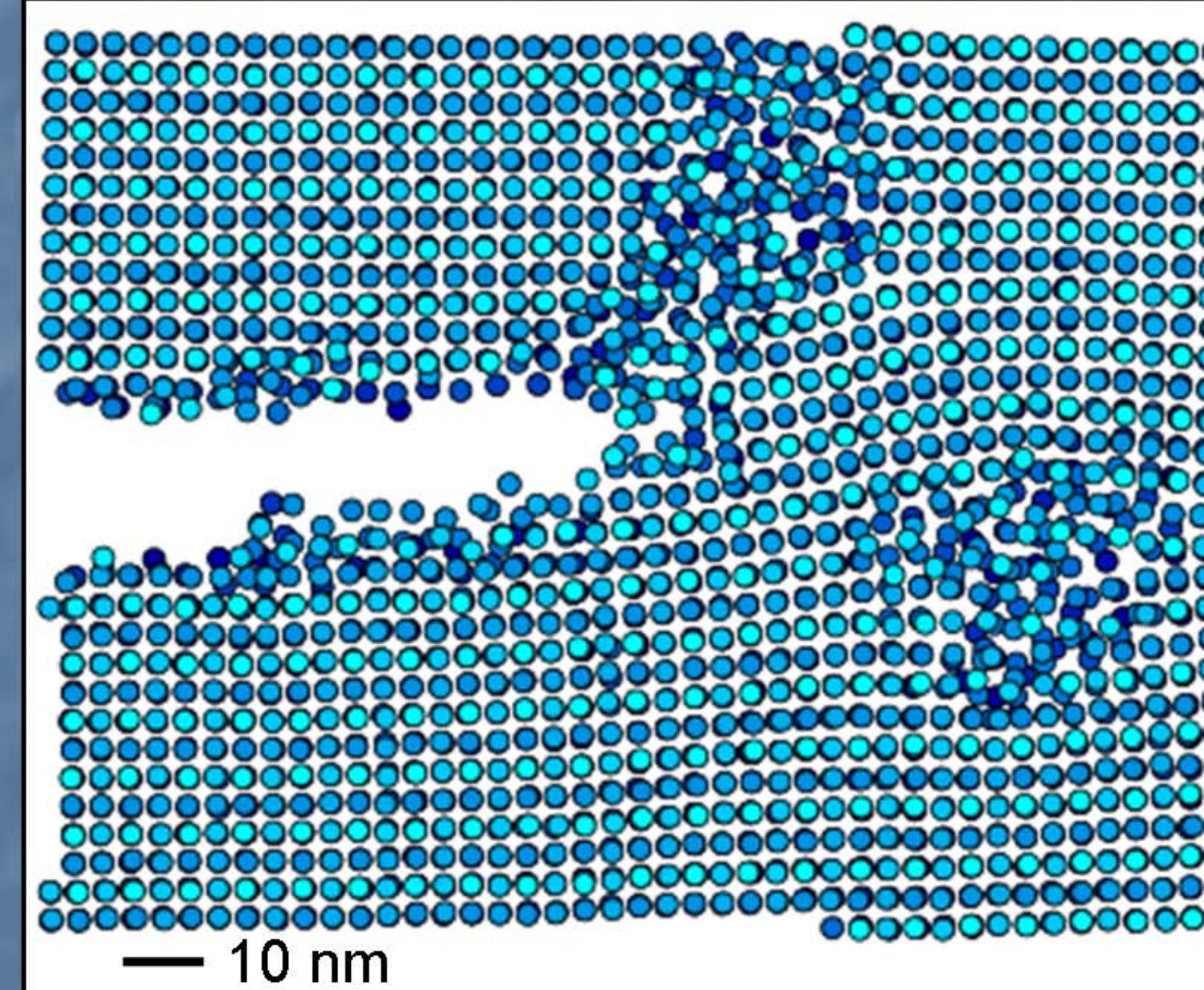
† Lawrence Livermore National Laboratory

MD calculations using the MEAM potential for silicon show that implantation creates nanostructured regions that increase fracture toughness

Detail of fracture propagating at 2 km/s on (110) planes through crystalline material



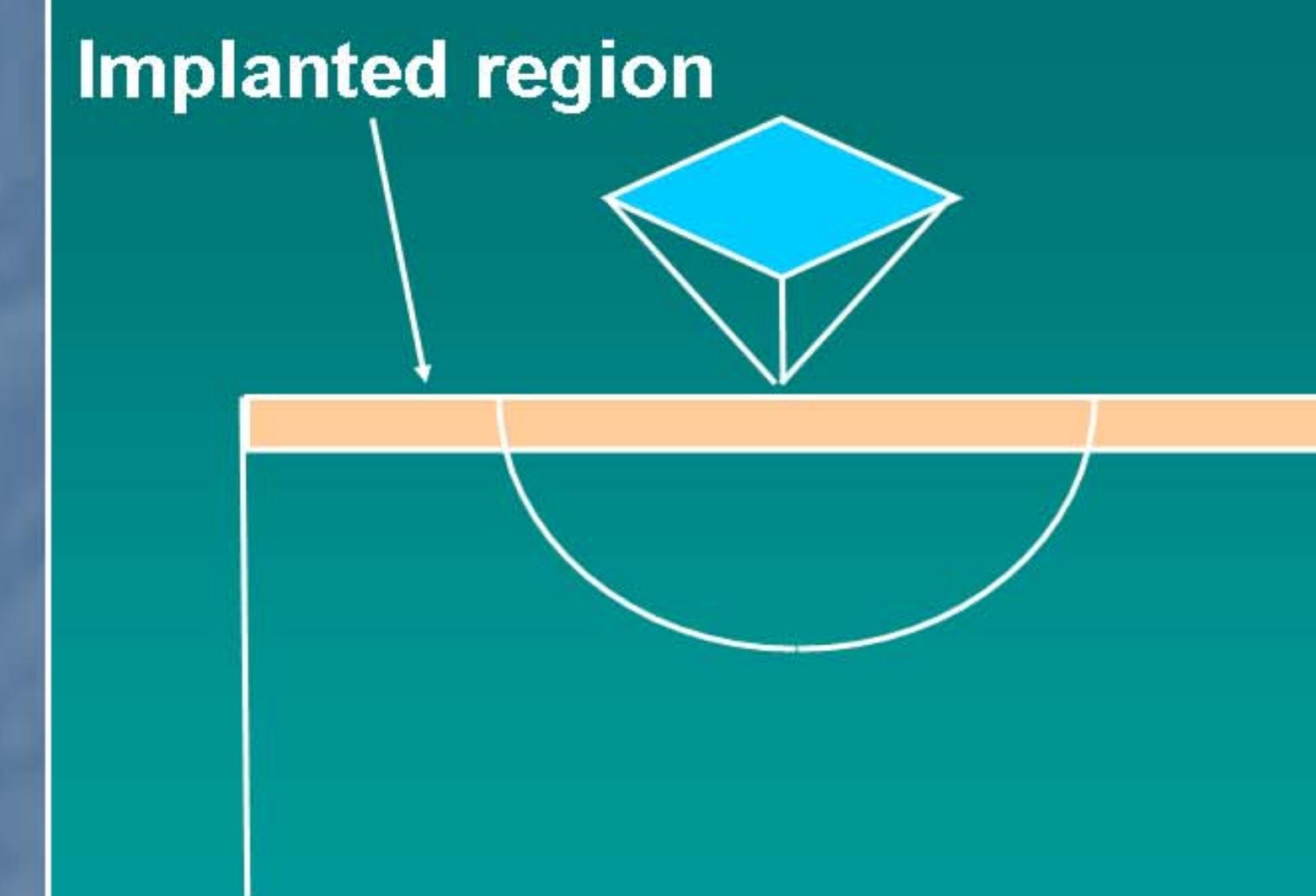
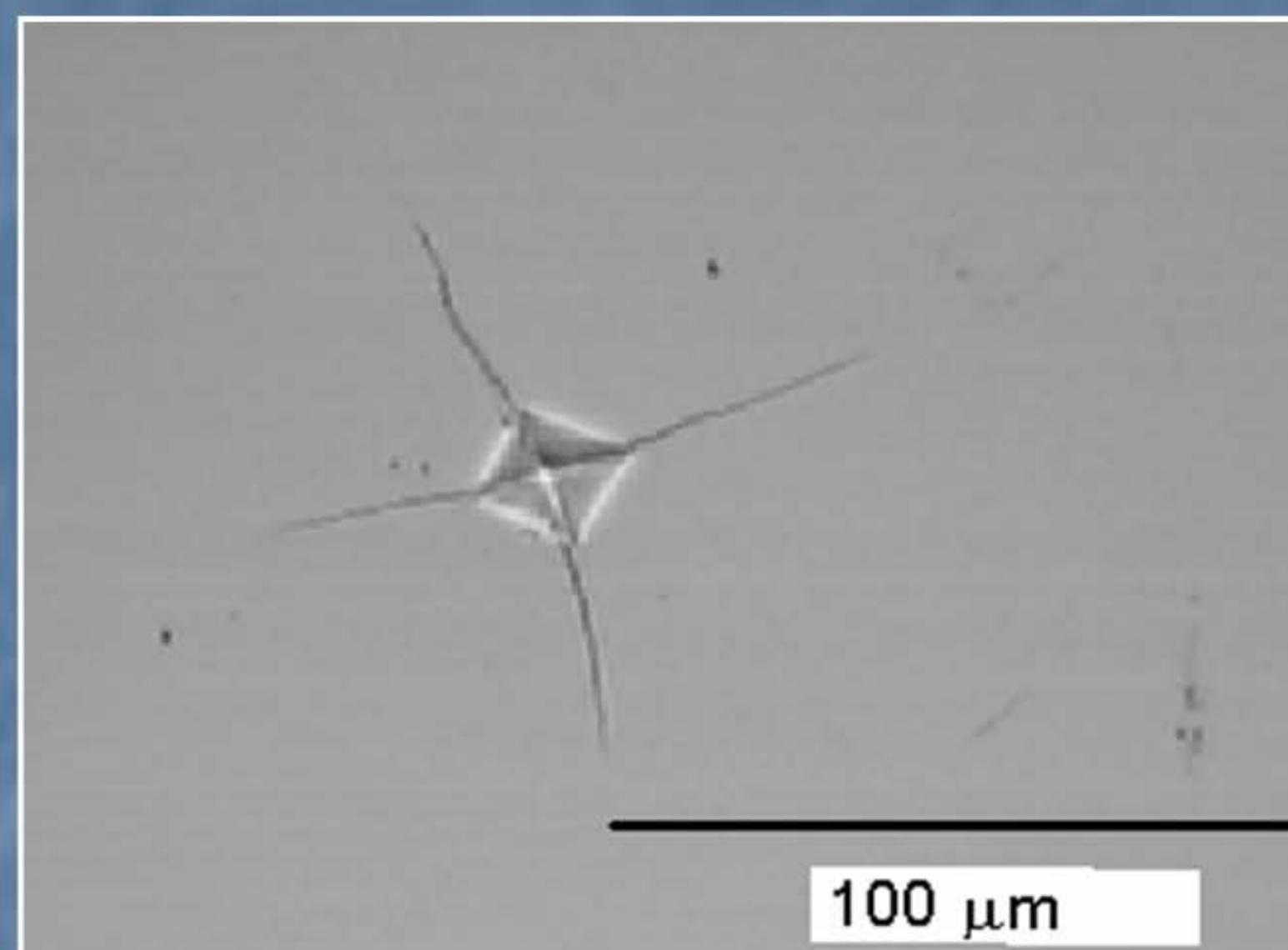
Damage cascades from 500 eV primary knock-on atoms



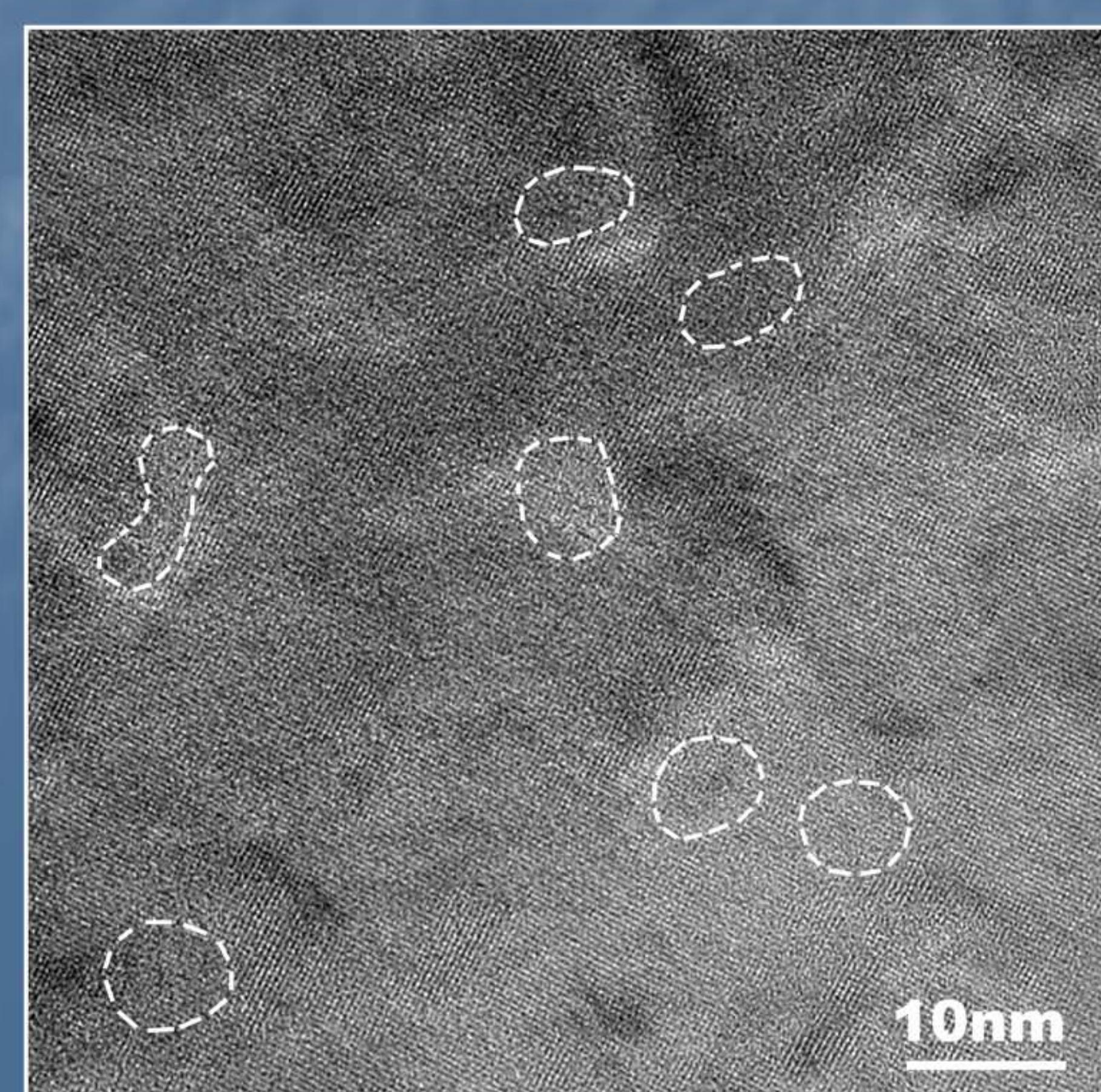
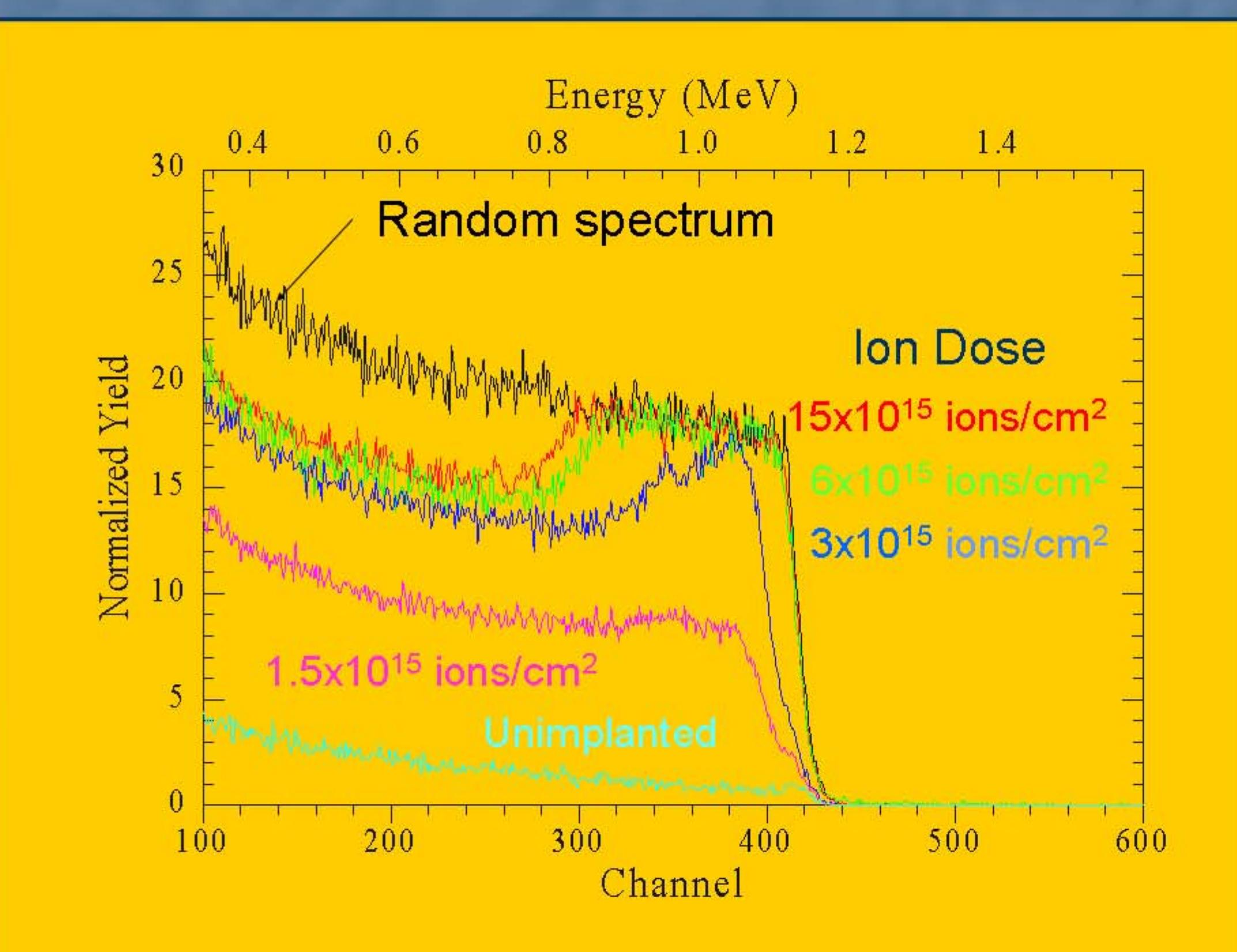
Fracture Toughness = 9.3 J/m<sup>2</sup>

Fracture toughness of ion implanted specimens is measured by indentation fracture experiments.

Note that cracks penetrate beyond the implanted layer.



RBS-C results for Ne implanted Si



TEM image showing amorphous regions in Si produced by 3x10<sup>15</sup> Ne ions/cm<sup>2</sup>

[1] M. I. Baskes (1987), Phys. Rev. Lett. **59**, 2666.

[2] J. G. Swadener, M. I. Baskes and M. Nastasi (2002) Phys. Rev. Lett. **89**, #085503.

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